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THE OREGON FOREST PRODUCTS LABORATORY[1]

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Lumber and forest products are critical war materials and as such are in great demand. Development of new and practical ways to utilize the unused portions of the forest by physical or chemical means is certainly consistent with good economy for the state and the nation. The progressive people who sponsored the act providing for research in the utilization of forest products had this in mind, and considerable progress has been made in this regard during the past biennium. However, it is the opinion of many that, in view of the relative importance of Oregon's forest resources to the state's economy, considerable more emphasis should be placed on this type of program.

Oregon leads all other states in respect to merchantable forest volume (approximately one-fourth of the national supply) and also in lumber production (more than 20 per cent of the annual total). This vast resource is vital to the economy of the state; it has been estimated as furnishing as high as 60 per cent of the annual income. The mature timber should be harvested and the cut-over lands kept in a satisfactory state of reproduction. Also, it is imperative that the material that is cut should produce as large a volume of products as is economically possible. In the past, when a tree was cut, roughly one-third was left in the woods as tops, limbs, or broken pieces. When the logs were cut up at the mill or fabricating plant, approximately one-half only was put on the market as lumber or lumber products and the remainder or the equivalent of one-third of the tree was unused. Recently there has been a good market for this material in many areas as fuel, but still large quantities are available for more valued uses. Added income from this "waste" will encourage loggers to bring more out of the woods and sawmill men to incorporate better utilization methods.

VOLUME OF WASTE

A recent survey by the Pacific Northwest Forest and Range Experiment Station at Portland shows that as of January 1944 there were 4,064 units of surplus waste sawmill material accumulating daily at seven milling centers in western Oregon. For the year this would total 1,056,640 units or tons dry weight. This amount is in excess of the material used and sold for fuel. One of the average-sized larger mills recently became concerned about its planer refuse. A check showed that the equivalent of 87,000 board feet of material came out daily at the "wrong" end of one planer. When we speak of waste, we must appreciate that this material accumulates as a natural result of the manufacturing or prefabricating process. However, it is possible to reduce the quantity and also to determine ways to use much of the sawdust, shavings, slabs, bark, trims, and edgings so that the operation will be benefited.

POLICY AND PROGRAM

The policy of the advisory group appointed to guide the research activities of the Oregon Forest Products Laboratory has been a broad one. First, while it is understood that there is much unused wood material at both the sawmills and in the woods, in view of present labor and transportation problems initial attention should be given to the accumulations at the mills. The "woods waste" will be considered later; also, it is known that the Washington Planning Commission is studying the woods material from a pulping standpoint. Second, the research work, as far as practicable, should be associated with the staffs and the facilities of the state institutions, especially Oregon State College. Third, the fullest knowledge should be obtained of work that has been done and is being done in fields related to Oregon's problems, especially at the U. S. Forest Products Laboratory at Madison, Wisconsin. It is recognized that a certain amount of duplication of study is necessary, but this should not be extensive.

The research program has been centered at Oregon State College in connection with the School of Forestry. The dean of the school is also the director of the laboratory. A spirit of cooperation is dominant and projects are under way with several other College departments, public agencies, and industrial organizations. It is felt that the size and scope of the whole problem justifies as much work being done as possible. Several of the associated College departments are: Wood Products, Chemistry, Chemical Engineering, Mechanical Engineering, Agricultural Engineering, and the Engineering Experiment Station. Cooperating public agencies are the state forester's office, the Secretary of State's office, and the Eugene Water Board. Industrial groups include the Timber

[1] Established by legislative act (see Oregon Laws 1941, chapter 468; revised in 1943 as chapter 259) which provided for research in fields of utilization, fabrication, and manufacture of forest products and the creation of an advisory committee of representatives of the West Coast Lumbermen's Association, the Western Pine Association, the Oregon Plywood Association, the Pacific Northwest Forest and Range Experiment Station, and the School of Forestry at Oregon State College. The Governor acts as chairman and the state forester as secretary.

Engineering Company, Portland, the Beaver Cabinet Works of Corvallis, and the Willamette Valley Wood Chemical Company of Eugene; Federal agencies are the Forest Products Laboratory at Madison, the Bonneville Power Administration at Portland, and the Electro-Development Laboratory of the Bureau of Mines at Albany.

It was necessary to make certain pilot plant installations of a character not adaptable to present College facilities, so a small laboratory building was constructed on the Oregon State campus. This combination tile and frame structure, 35 by 40 feet, with a second story over half of it, houses the carbonization retort, the grinding, chipping, mixing, and screening equipment, and certain chemical laboratory facilities.

CURRENT PROJECTS

The inventory of sawmill waste showed that there were thousands of tons of woody material lying unused at the sawmills. As a result, the first studies were pointed toward the use of as large amounts as possible—quantity use rather than quality use. These same approaches to an attempted solution to the problem are being followed now, with some changes due to the war situation. The projects outlined originally were: making of a wall plaster from a sawdust base, the bonding of sawdust or wood flour into boards or other plastic material, the carbonization of sawdust, and the separation of the cork from Douglas fir bark and its uses in a bonded material.

These projects are still being carried on, though with some shift of emphasis due to war demands. Carbonization of wood waste is very important, because of the need for charcoal as a fuel in the metallurgical industry. Interest in the hardwood species has increased because of a current shortage of softwood lumber and other products. There is a special interest in the byproducts of the Scholler method of wood hydrolysis, stimulated by the construction of the plant at Springfield where ethyl alcohol will be made from wood cellulose. Each of these major projects will be discussed briefly with some mention of other minor studies.

Wood Carbonization. The carbonization of wood waste to produce a high-grade metallurgical fuel which also will have potentialities as a commercial and domestic fuel has had major emphasis. A pilot plant using a horizontal rotary retort is now in operation. Douglas fir headsaw sawdust has been the only material carbonized to date, because of the necessity of working with a uniform raw material.

The project has been divided into the charring operation, the briqueting of the charcoal and subsequent coking of the briquets, and the analysis of recovered tars. In the preparation of the charcoal a procedure has been followed which will lead to the optimum conditions for the design of a 50-ton per day charcoal plant. Four units[2] of sawdust are required to produce a ton of charcoal in the internally fired rotary retort. The approximate processing cost is $5.50 per ton of charcoal.

The briqueting study is designed to develop a dense, strong briquet which will be waterproof and resistant to size degradation in handling and use. A strong, dense, water-resistant briquet has been produced with a binder of the wood-tar water emulsion recovered in the process. The tar-charcoal mixture is briqueted in a rotary press and recarbonized to a low volatile product. Various types of tar and pitch binders have been utilized.

The pilot plant is set up for by-product recovery. Because early preliminary tests showed the presence of valuable constituents in the recovered tars, an investigation of this material has been undertaken. An A.S.T.M.[3] distillation of the primary tar gave 36.4 per cent tar acids in the distillate, while a vacuum distillation produced 44.4 per cent. The tar acids are of interest because these materials might form the raw material for plastic materials, including plywood adhesives.

Sawdust Plaster. The idea that raw sawdust might be mixed with a bonding agent and be used as a plaster material is still being investigated. If practicable, this use could absorb a considerable bulk of "waste." Hundreds of different combinations of material and synthetic resins have been tried. Ordinary sawdust has been mixed and applied to several kinds of wall surfaces with a trowel. Large-scale applications on wall panels built up of 6-inch boards have shown some cracking. Plywood panels are still to be tried. It would appear that economy of labor and some refinement of appearance would result from grinding the sawdust to wood flour and making the mixture suitable for a spray applicator, especially for a solid flat surface. A spray-painting equipment firm has been asked to make recommendations. The cost of the plaster for covering to a depth of 1/16 inch is estimated at 10 cents per square yard. Preliminary tests show that the material will take coloring either before or after the wall application.

Further studies will include the use of the spray equipment, testing of the coatings for drying reactions, possible modification of the present formula, and a compilation of cost figures.

Plastics—Bonded Boards. This phase of the problem offers many possibilities and there is considerable interest in it. Experiments have included the bonding of wood with synthetic resins and attempts to utilize the bonding properties of the lignin present in the wood. Several different resins have been tried. Best outlooks are for the use of the lignin bonding properties of the wood. But to make satisfactory bonded products it will be necessary to plasticize the lignin to obtain better flow quality and then modify it to give more thermo-setting characteristics.

An attempt is being made to fabricate an auto-license plate. While a satisfactory plate can be built of impregnated plywood, it is hoped to use waste

[2] A unit contains 200 cu. ft. of gravity settled material containing 2,000 lbs. of dry wood.

[3] American Society for Testing Materials.

materials. A cooperative arrangement has been made with an industrial concern and the outlook is promising. Shavings or defibered wood, bonded with a resin, seem to offer the best chances.

Studies will be continued looking toward the fabrication of (1) a low-density, good insulating board for the backing of veneers, (2) a high-density board for use as flooring, wall panels, or furniture, and (3) the use of Scholler lignin with wood-waste mixtures.

Douglas Fir Bark Cork. This study consists of (1) development of a method of separating cork from the bark, (2) preparation of composition cork from the crude cork, (3) investigation of the compressibility qualities of the composition, and (4) chemical analysis of the cork. Other phases to be considered are studies of the insulating qualities of the cork and the utilization of the bark residue after separation of the cork.

It appears quite evident that any successful process for preparing Douglas fir bark cork must include a means of utilizing the bark residue after separation of the cork. Preliminary experiments have shown that this residue contains considerable tannin and wax. Extraction studies now under way may lead to some use for this residue. Another possible use is to bond this fibrous material by heat and pressure to make wall board.

Utilization of Oregon Hardwoods and Other Minor Species. Oregon's hardwood inventory of some 4,000,000,000 board feet, in addition to certain coniferous species such as lodgepole pine and juniper, represents a potential resource for the development of several new sizable industries. The major hardwood species are red alder, Oregon white oak, bigleaf maple, Oregon ash, northern black cottonwood, tan oak, madrone, myrtle, and chinquapin. Juniper and the Port Orford cedar offer possibilities because of the oils contained within the wood. It has been established in a limited way that lumber from the woods listed above can be manufactured and used in a satisfactory manner. The State Forestry Building at Salem is an example. Furniture, ties, lumber, boxing, pulp, and chemical uses offer a challenge. In order to promote the successful use of these species, rather complete studies in management and utilization will be necessary.

Scholler Lignin—Alcohol Plant By-Products. The establishment of the plant at Springfield where ethyl alcohol will be made from wood waste for war purposes presents many new research problems. The continuation of this type of industry after the war will depend largely on the use that can be made of the present by-products—namely, 50 tons of Scholler lignin, 14 tons of calcium-sulphate sludge, and 400,000 gallons of "still bottom" liquor daily. The possible conversion of the plant, or the construction of others, for the production of high-protein feeding yeasts also merits study, in view of the demand for livestock and poultry feeds in the Northwest.

The laboratory has made only a small start toward solution of the problem of alcohol wastes, working particularly with the lignin. A cooperative arrangement is planned with the operating company of the plant. Present studies have pointed toward:

Use of Lignin for Fuel. This is low-value use in the range of $8.00 to $15.00 per ton. Calorimeter tests indicate a fuel value slightly higher than the average for Douglas fir wood. For domestic fuel the lignin may be briqueted and used directly. Lignin may be combined with charcoal to form a briquet, if pressures and temperatures are carried high enough. The lignin may be readily carbonized with a considerably higher yield than wood of both char and tar.

Use of Lignin as an Extender. A very good possibility exists of using lignin as a conditioner for orchard-dusting compounds, as a carrier for fertilizer, and as an extender in plastics and resin adhesives. Lignin offers some possibility as a competitor for peat moss (retail, $60.00 per ton); as a soil lightening and acidifying agent; and as a replacement for walnut shell, wheat, and wood flour as an extender in plastics and adhesives, at values up to $80.00 per ton. Samples of the lignin have been sent to fourteen manufacturers of equipment, resins, plastics, and insecticides.

Use of Lignin for Plastics. Lignin alone will not flow readily at low temperatures and will not produce strong and water-resistant plastics. It can be modified, however, to improve these properties. Modification may take the form of merely adding fortifying agents or of chemically changing the lignin. Initial experiments show much promise, and it is hoped that this new material will prove chemically reactive to the point of forming a basis for a desirable plastic compound or resin adhesive.

Fuel Studies. A series of burning tests have been made with a domestic sawdust burner, using hemlock and Douglas fir sawdust in combination and with high heat-value solid fuels. The purpose of these tests was to investigate the relative burning characteristics and heat values of the various materials. The results were published in Research Leaflet No. 1, and also formed the basis of a publication by the Northwest Solid Fuels Rationing Branch, Office of Price Administration.

The loss of heat value and the factors associated with such loss in stored hogged fuel and sawdust are being investigated in cooperation with the Eugene Water Board. A sample pile has been built which contains thermocouples for temperature measurement at various points. Samples of the fuel will be analyzed after various periods of storage.

Gasogene Generator. A generator was made available by the Timber Engineering Company and has been installed on one of the School of Forestry trucks. This equipment converts charcoal and air into a combustible gas which is suitable for use in

internal combustion engines. The College departments of Agricultural Engineering and Mechanical Engineering are cooperating.

PLANS FOR THE FUTURE

Oregon's position as a producer of forest products merits special attention to methods which will lead to a fuller use of all wood material, both by physical and chemical means. As has been indicated, the scope of the whole problem of complete forest utilization is a broad one. However, the interest from the economic as well as the conservation point of view justifies immediate consideration. The interest of organizations and individuals is also high, as shown by letter inquiries numbering more than 125 during the past year.

The possibilities for further studies are many and varied and are limited only by the staff and equipment. The offers of cooperation from public and private interests are numerous, and it is hoped that the program will be expanded in order that all problem areas may be considered.

Major efforts in the immediate future should be expended in the fields of carbonization, utilization of the hardwood and minor softwood species, use of the by-products of the wood chemical plant at Springfield, and use of wood "waste" in making plasticized products. It must also be kept in mind that our present utilization practices of leaving quantities of material in the woods, as well as the sawdust and hogged-wood piles at the mills, are a challenge. The aim should be to use all of the three-thirds of the tree. It will be good state economy to approach this problem as soon as possible.

OREGON BUSINESS -- SEPTEMBER 1944

BANK DEBITS

Bank debits represent the dollar value of checks drawn against individual bank deposits. Approximately 90 per cent of all goods, property, and services is paid for by check. Bank debits are regarded as indicators of the general trend of business and for this reason the Bureau of Business Research collects bank debits from 88 banks and branches monthly.

Marketing Districts	Number of Banks Reporting	Debits Sept. 1944	Debits Aug. 1944	Debits Sept. 1943	Compared with Aug. 1944	Compared with Sept. 1943
Oregon	88	$640,454,512	$629,966,938	$707,609,906	+1.7%	−9.5%
Portland	25	450,562,436	453,325,646	501,468,371	−0.6	−10.2
Lower Willamette Valley	9	43,338,944	42,437,334	44,015,593	+2.1	−1.5
Upper Willamette Valley	11	39,574,370	37,115,923	45,508,031	+6.6	−13.0
North Oregon Coast	4	15,857,783	15,489,638	17,467,461	+2.4	−9.2
Douglas, Coos Bay	5	9,871,297	9,848,352	9,392,736	+0.2	+5.1
Southern Oregon	5	17,251,575	15,987,752	18,649,419	+7.9	−7.5
Upper Columbia River	6	10,943,371	9,119,620	12,353.404	+20.0	−11.4
Pendleton	5	13,405,267	12,095,303	17,148,373	+10.8	−21.8
Central Oregon	4	6,980,439	6,494,672	9,521,656	+7.5	−26,7
Klamath Falls, Lakeview	4	18,044,659	14,811,601	18,477,854	+21.8	−2.3
Baker, La Grande	7	9,873,050	8,956,623	10,586,212	+10.2	−6.7
Burns, Ontario	3	4,751,321	4,284,474	3,020,796	+10.9	+57.3

RETAIL SALES

The sales of a state-wide sample of 493 independent retail stores, collected by the Bureau of the Census, gives an indication of trading activity and retail distribution. These figures are often interpreted as reflecting purchasing power.

BY MARKETING DISTRICTS

	Compared with Aug. 1944	Compared with Sept. 1943
Oregon	+7.2%	+14.7%
Portland	+6.2	+8.9
Lower Willamette Valley	+14.9	+25.9
Upper Willamette Valley	+2.9	+5.6
North Oregon Coast	+10.1	+7.3
Douglas, Coos Bay	+6.9	+29.4
Southern Oregon	+14.0	+112.6
Upper Columbia River and Pendleton	+14.0	+6.1
Central Oregon, K. Falls, Lakeview	+14.5	+21.2
Baker, La Grande, Burns, Ontario	+10.2	+20.0

BY TYPE OF OUTLET

	Compared with Aug. 1944	Compared with Sept. 1943
Oregon	+7.2%	+14.7%
Department Stores	+7.3	+18.1
Food Stores	+0.1	+15.3
Eating and Drinking	−3.5	−3.2
Drug Stores	+8.1	+10.2
Apparel Stores	+26.8	+18.5
Motor Vehicle Dealers	−5.5	+2.9
Furniture, Household, Radio	+26.4	−0.1
Lumber, Building, Hardware	−3.4	+8.0

BUILDING PERMITS

Building permits give an indication of building operations planned rather than actual construction under way. Care must be taken in interpreting these data to allow for the lag which may elapse between the issuance of the permit and the beginning of actual construction.

	Sept. 1944	Aug. 1944	Sept. 1943
Astoria	$ 6.970	$ 9,935	$ 48,025
Baker	7,950	170	100
Bend	750	600	149,475
Eugene	64,177	59,365	15,636
Klamath Falls	no report	no report	9,085
Medford	6,966	2,173	no report
Portland	173,545	550,580	1,451,665
Salem	no report	13,276	19,638
30 other communities	133,240	436,249	266,139
Total	$ 393,598	$1,072,348	$1,959,763

LUMBER PRODUCTION

The West Coast Lumbermen's Association reports the September 1944 weekly average of lumber production in western Oregon and western Washington was 149,736,000 board feet. This compares with a weekly average of 157,151.000 board feet in August 1944 and 161,919.000 board feet in September 1943.

COMMERCIAL FAILURES

There were no commercial failures in September 1944. This compares with one failure involving liabilities of $25,000 in August, and one with liabilities of $6,000 in September 1943.